

FEASIBILITY OF NEW COAL FUELED POWER PLANTS

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Feasibility of New Coal Fueled Power Plants In the US

(presenter: Natalie Rolph, Chief Economist
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ABSTRACT

This paper discusses how the differential between natural gas and coal prices, and the difference in public versus private financing affects the financial feasibility of new coal plants in the US. Recent advances in the design of new coal generators and coal plant systems are described. Opportunities and implications of using cheaper, lower quality coals are addressed, as are the impacts of plant size, ideal site conditions and more stringent environmental regulations. Implications for US coal industry suppliers are suggested.

*Coal In Sustainable Development
in the 21st Century*



Feasibility of New Coal Fueled Power Plants In the US

Natalie Rolph



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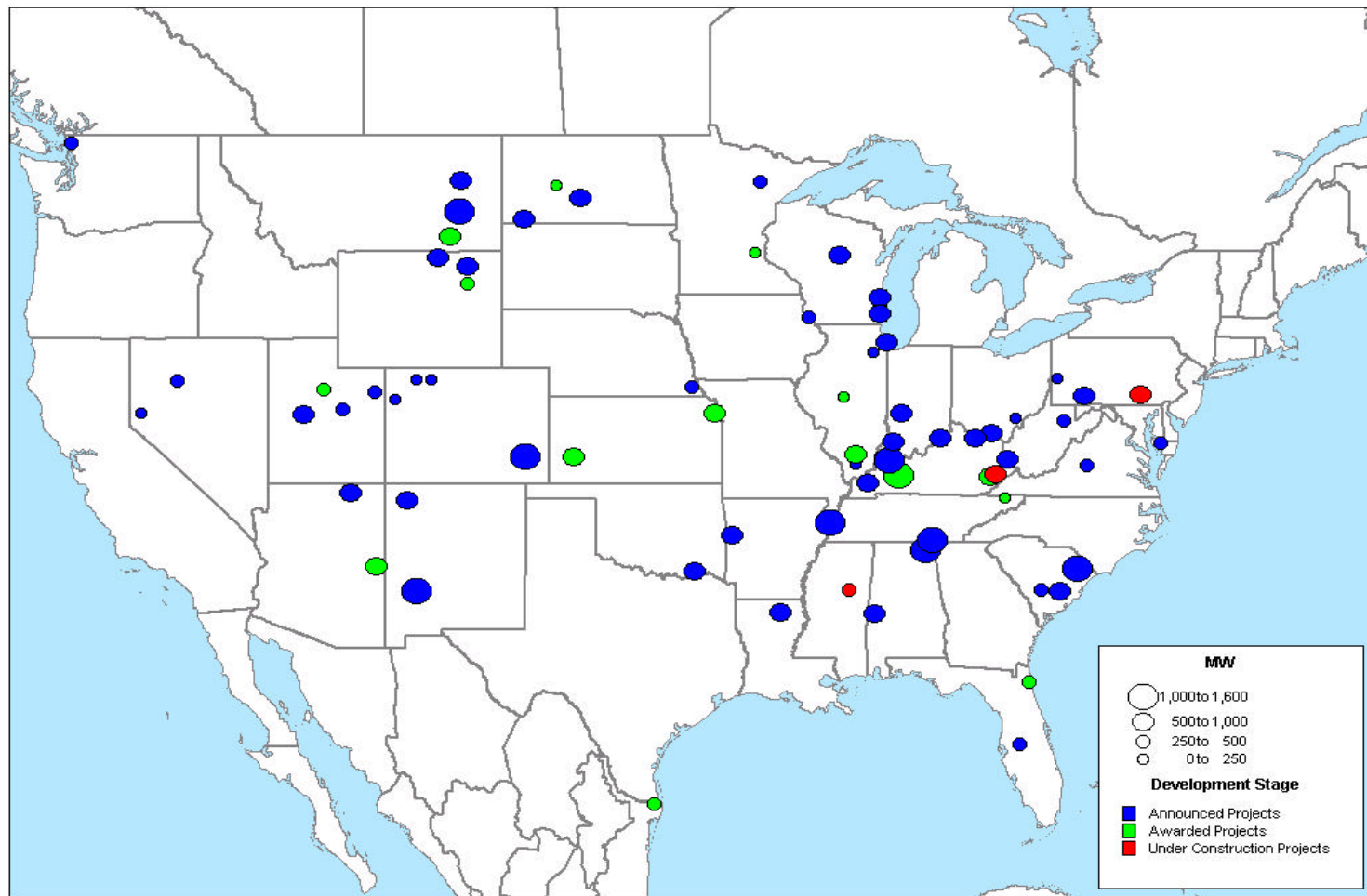
Topics

- New Interest in Coal Generation
- Recent Design Enhancements / Current Configurations and Costs
- Private Developer Economics
- Regulated and Public Power Economics
- Factors That Alter Coal Economics
- Implications for Coal Industry Suppliers

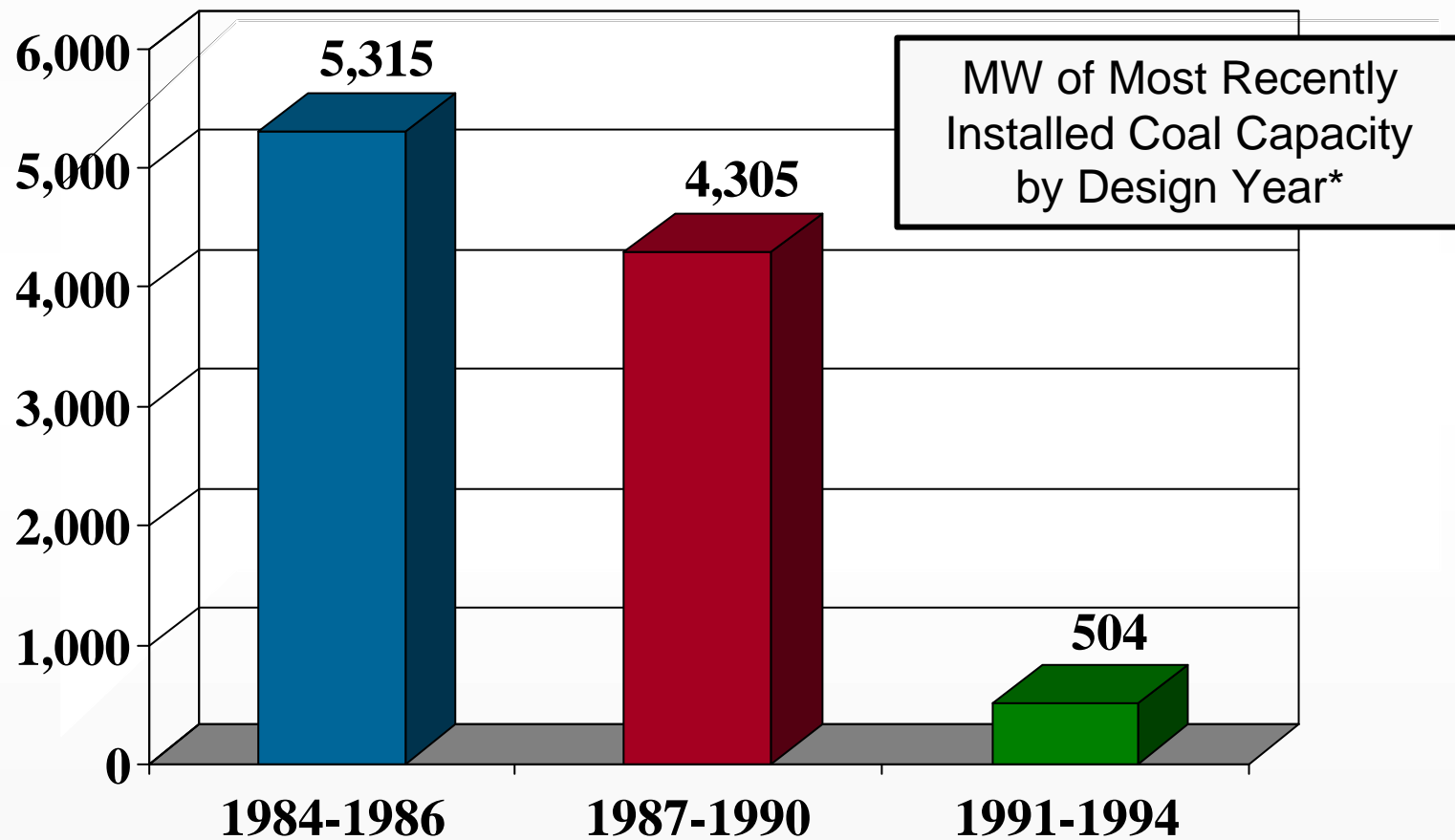


New Interest in Coal Plant Development

Announced US Coal Projects



Actual US Coal Plant Designs >10 Years Old



* Assumes Typical Design Lead Times 6 Years Prior to Commercial Operation



Recent Turbine and Boiler Design Enhancements

To Reduce Capital Costs or Improve Efficiency

- Turbine Enhancements - Increased Output From
 - HP / IP Material Advances
 - Longer LP Turbine Blades
- Boiler Enhancements
 - Proven Supercritical Performance (Asia & Europe)
 - Combustion Control Improvements



Design Enhancements to Meet New Environmental Constraints

- In Response to New NO_x Limits
 - Demonstrated SCR Experience to 0.09 lbs / MBtu
- In Response to New SO₂ BACT Levels - Commercial Maturity for
 - Wet FGD
 - Spray Dryer Absorber
 - Circulating Dry Scrubber



Design Enhancements to Meet New Emission Limits

Tougher SO₂ Limits (Assuming Western Coal)

- Dry Scrubbers and New Fabric Filters Offer
 - Lower Capital Costs
 - Greater Secondary Removal
 - Clearer Plume
 - Less Corrosion
- Polishing Scrubbers Provide Added Removal in Sensitive Areas



Representative New Coal Plant Configuration

- Plant Characteristics - Assuming Western Coal
 - Single Unit Site - 500 to 750 MW
 - Subcritical PC Boiler
 - Tandem Compound Four Flow Turbine
 - SCR for NO_x Control
 - Spray Dryer Absorber With Fabric Filter for SO₂ Control
 - Coal Unloading Facilities to Accommodate Delivery by Rail or Conveyor
 - Mechanical Draft Cooling Tower
- Construction Cost of Approximately \$1,200 - \$1,400 / kW
- Net Plant Heat Rate of 9,400-9,500 Btu / kWh



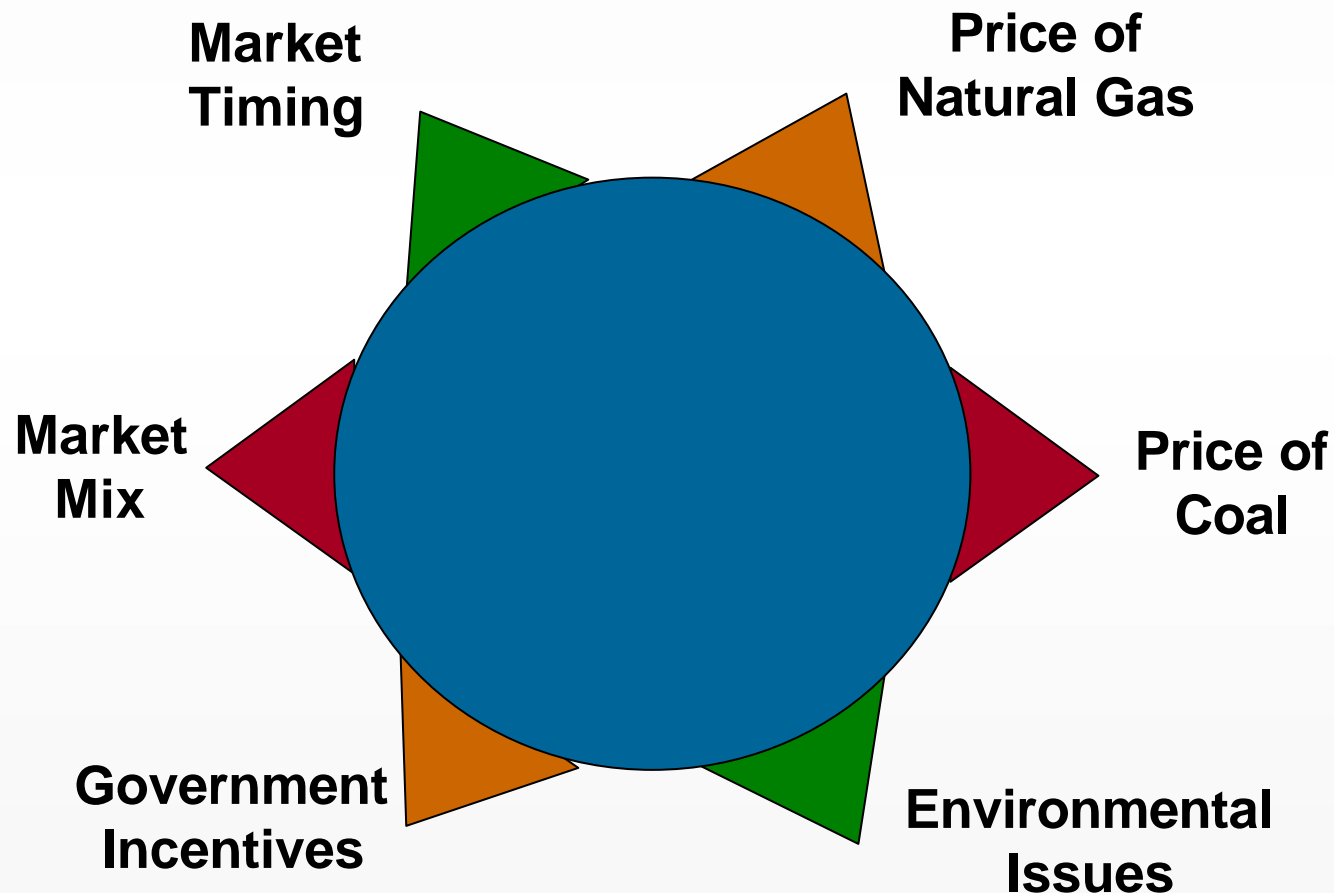
Ways to Minimize New Coal Development / Construction Costs

- Two-Unit Sites Reduce Capital Costs per kW by Approximately 6% and Fixed O&M by 25-30%
- Use of Existing Coal Handling Facilities May Reduce Capital Costs by as Much as \$50 / kW
- Use of Existing Site May Allow Modification of Existing Permits, Consideration of Net Emissions and / or Reduced Lead Times



Can Private Coal Generation Earn Combined Cycle Returns?

Private Development Drivers



Case Study Analysis

- Using B&V's Data Base of Construction Costs and Performance Estimates
- Using Financing Cost Assumptions from Independent Engineering Assignments
- Using Electric and Gas Market Price Forecasts from Recent Consulting Assignments
 - For the Somewhat Extreme Markets of California and the Mid Continent Area Power Pool (MAPP)



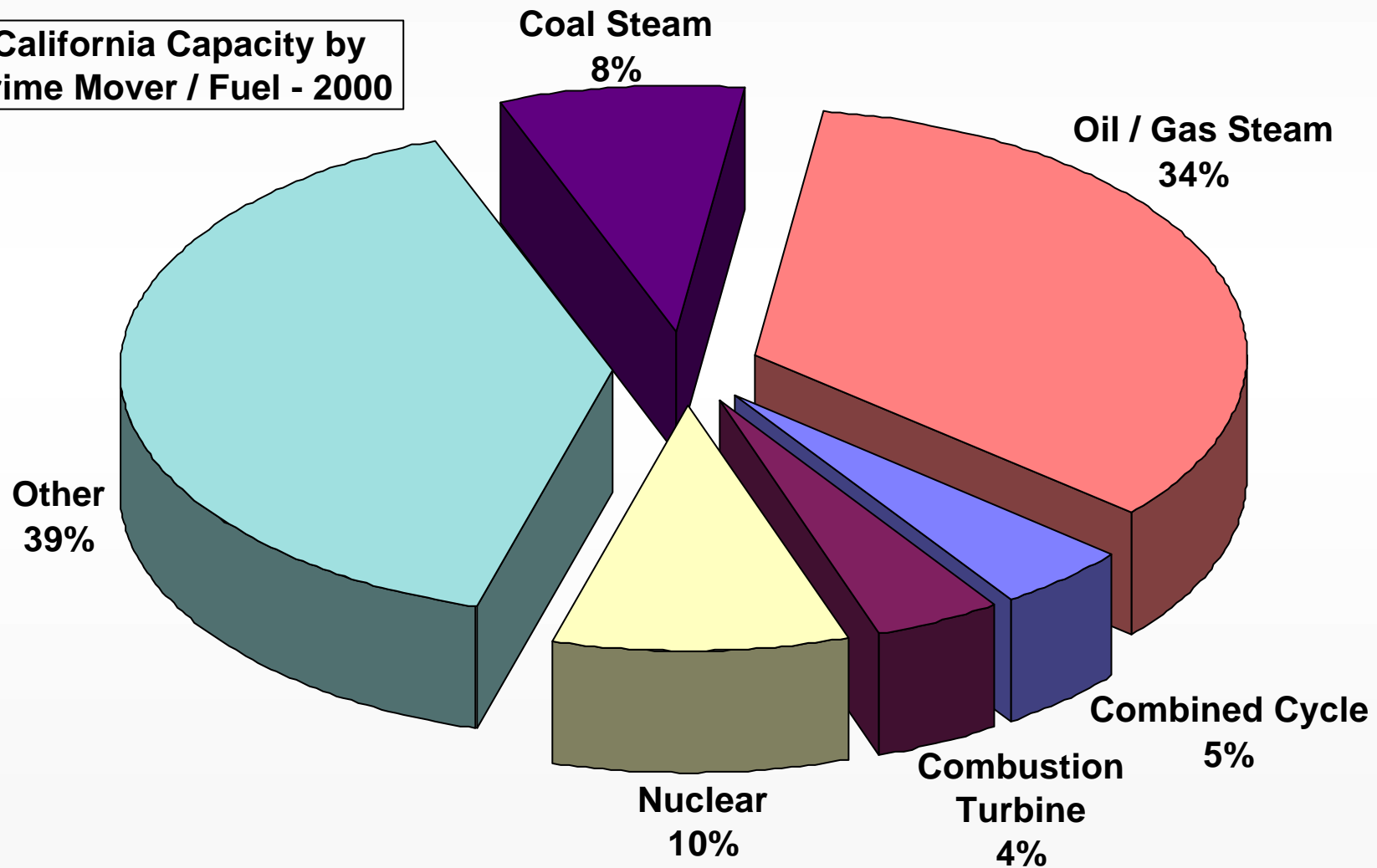
Market Timing

- New Coal Generation Is Not Competitive in Markets With Sufficient Capacity
- The Need for Additional Generating Capacity Is Worth \$60-\$105 / kW-Year Based on the Long-Run Marginal Cost of New Combustion Turbine Capacity



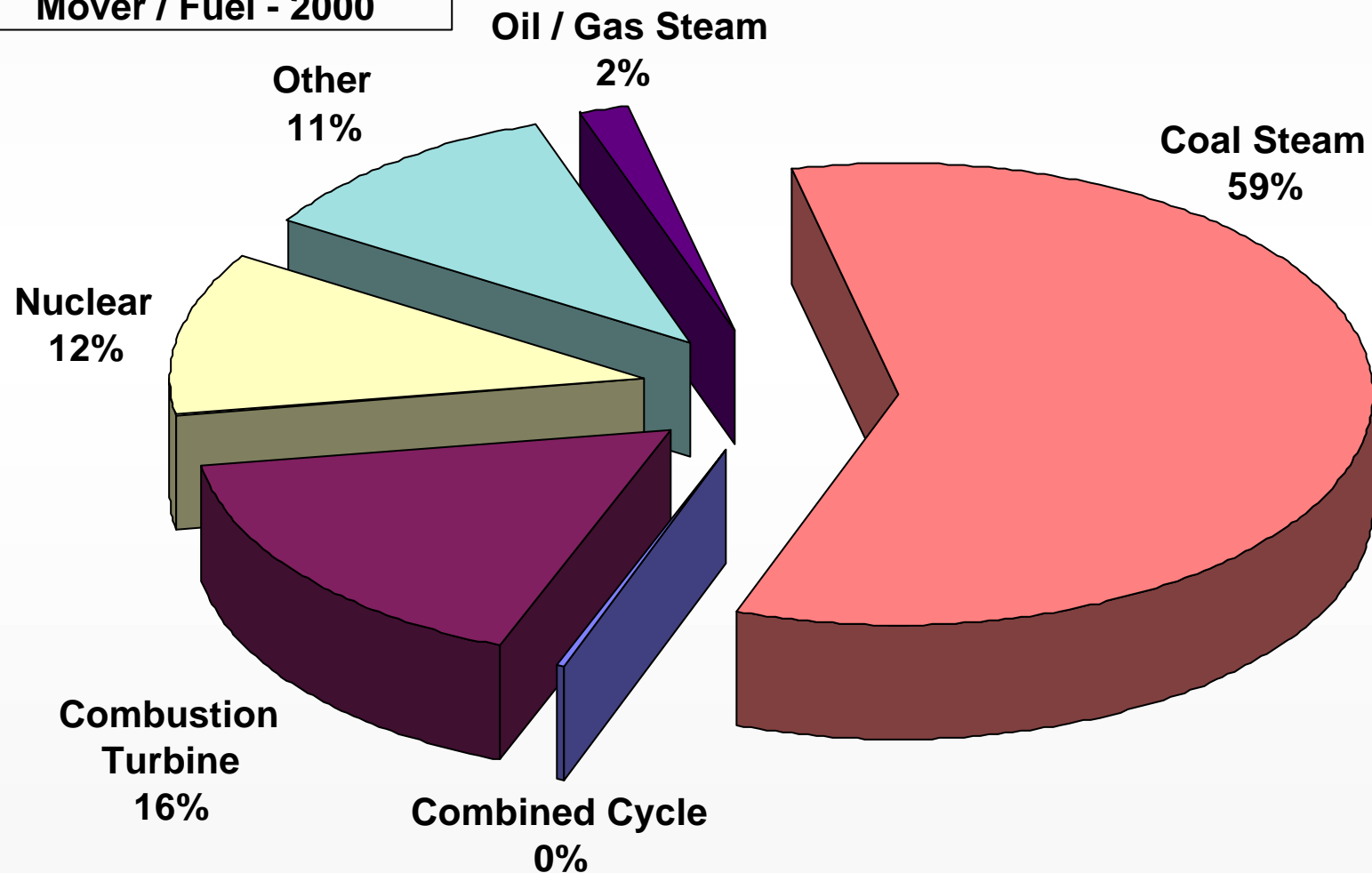
Existing California Market Mix

California Capacity by
Prime Mover / Fuel - 2000

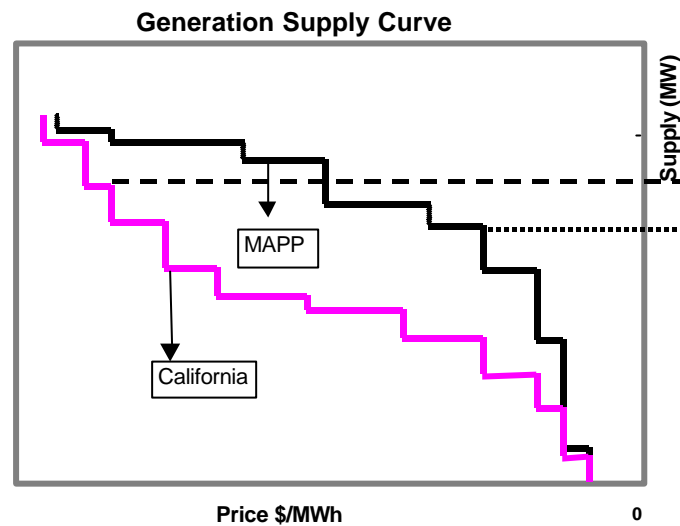


Existing MAPP Market Mix

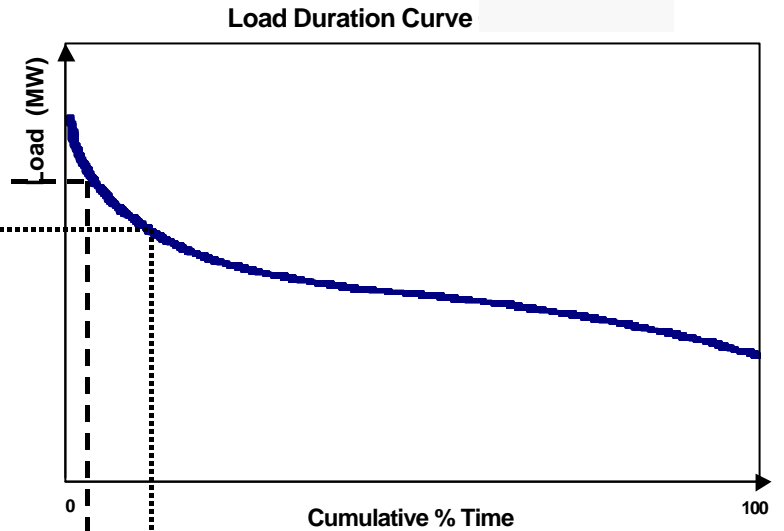
MAPP Capacity by Prime
Mover / Fuel - 2000



Supply

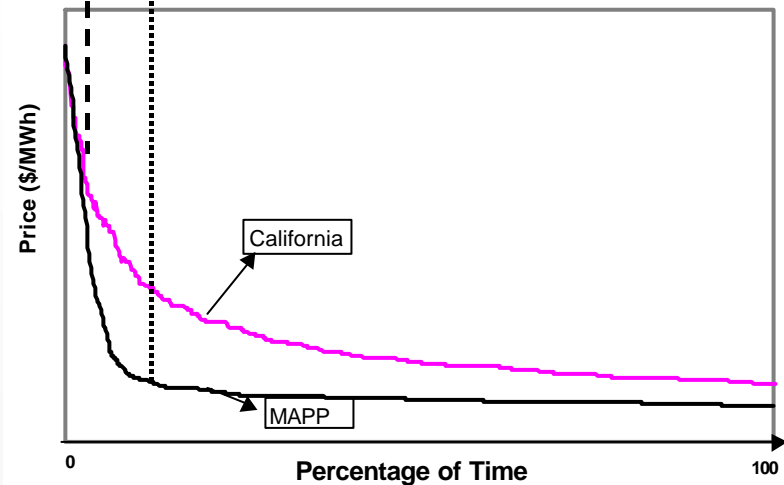


Demand



Price

Market Clearing Price



**Coal Plant Revenue
Is Dependent on
the Market**



Delivered Fuel Price Assumptions in 2005 (\$/MBtu)

■ Gas

- MAPP - \$3.60 + 60% - 25%
- California - \$3.90 + 60% - 25%
- 2.5% Escalation

■ Coal

- MAPP - \$0.64
- California - \$1.25
- 2.0% Escalation



New Entrant Financing Assumptions

- 17-Year Debt Term
- 60 / 40 Debt-Equity
- 20-Year Equity Return Period
- 8% Interest
- 15% Return on Equity
- 39% Effective Income Tax
- 10% Coal Indirects
- 20% Combined Cycle Indirects
- \$550/kW Construction Cost
- 6,900 Btu/kWh Heat Rate



Observations Regarding the Competitive Costs of New Coal Plants in California and MAPP

- The Market Offers Nearly 20% Higher Total Revenues in WSCC
- However, if Coal Prices Are Over 90% Higher, Any Market Advantage Is Lost
- The Threshold Construction Cost of a New Coal Plant in California or MAPP Is Approximately \$1,000 / kW



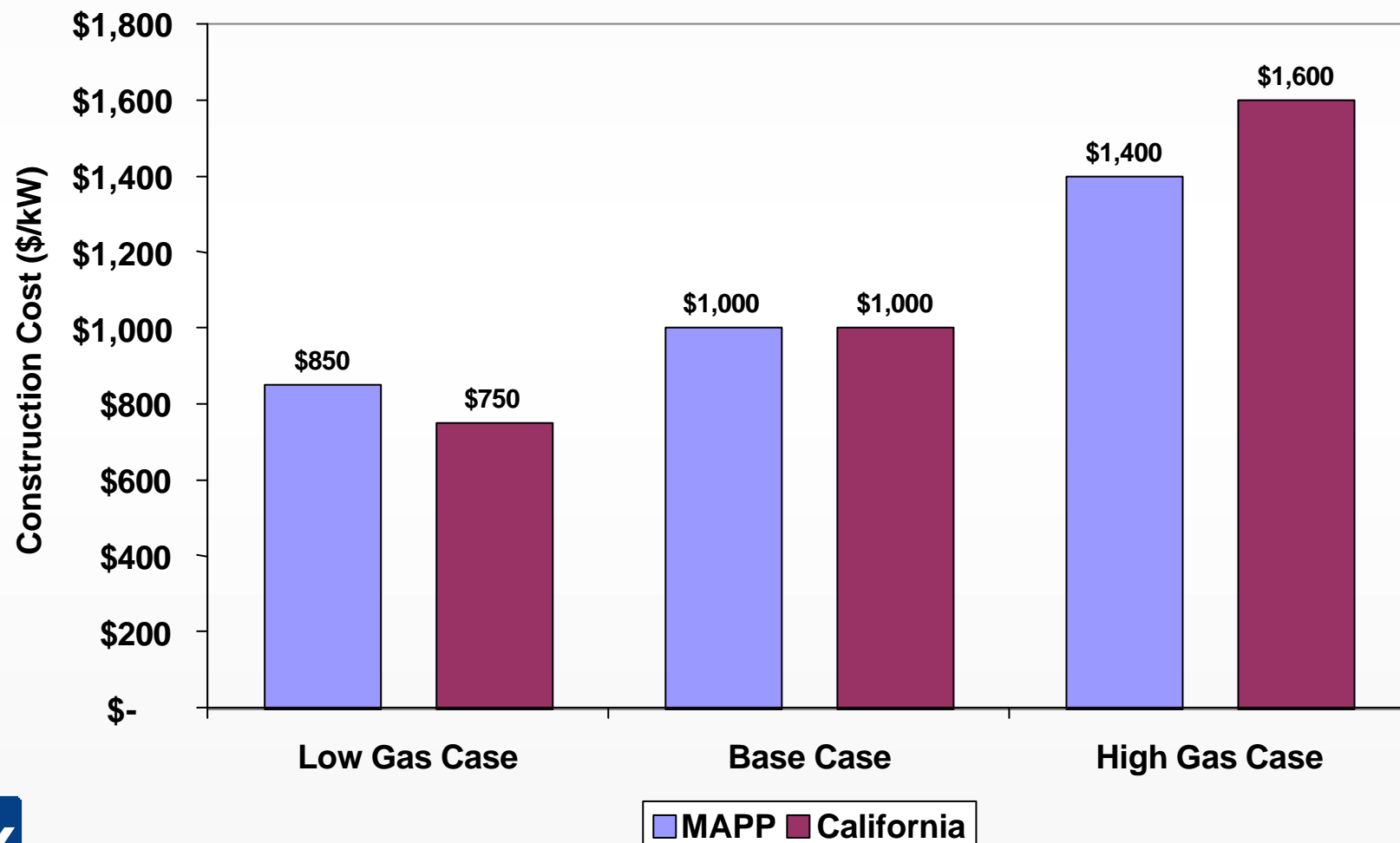
Factors That Can Alter the Threshold Construction Cost of New Coal Plants

- Alternative Gas Price Assumptions
- Competitive Coal Pricing
- New Environmental Rules
- Financing Costs / Desire for Price Stability



Private Developer Economics

Threshold Construction Cost for New Coal Fueled Capacity



Regionally Competitive Coal Supports Higher Construction Costs

- Use of Low Cost, Mine Mouth Coal Priced 40 % Below the Region Supports an Additional \$200 - \$300 Per kW in Construction Costs
- New Generation at Existing Sites Offer Opportunities to Renegotiate Coal Supply Contracts for Existing Generators



Should Waste Coal Be Considered in Developing a Competitive New Coal Plant?

- Waste Coal Properties Vary Greatly
 - Lower Btu Coals Require Proportionately Large Material Handling Facilities and Boilers
 - Additional Environmental Controls, Such as Polishing Scrubbers for High Sulfur Petroleum Coke, May Be Required
- At Best, the Capital Cost Premium Is \$200 Per kW
- If the \$200 Capital Cost Premium Can Be Offset by a Fuel Price Advantage in Excess of 50¢ to 60¢ Per MBtu, the Use of Waste Coal Should Be Considered



Impacts of New Environmental Rules

- Impacts Must Be Considered From a Market-Wide Perspective
- Existing Coal Plants May Spend Much More to Comply Than New Coal Plants
- Black & Veatch Estimated Impacts of Phase II SO₂ Limits and the NO_x SIP Call in the MAIN / ECAR Market
 - Assumes \$4,500 / Ton NO_x Allowance Cost
 - Assumes \$150 / Ton SO₂ Allowance Cost
 - MAIN / ECAR Market Prices Rise \$5-\$6 / MWh
 - New Coal Plant Cost of Allowances <\$2.25 / MWh (0.25 lbs / MBtu SO₂, 0.09 lbs / MBtu NO_x)
- Current Carbon Tax Proposals, if Enacted, Would Destroy the Coal Generation Industry



A New Twist on Traditional Development

Desire for
Price
Stability

Is Pushing

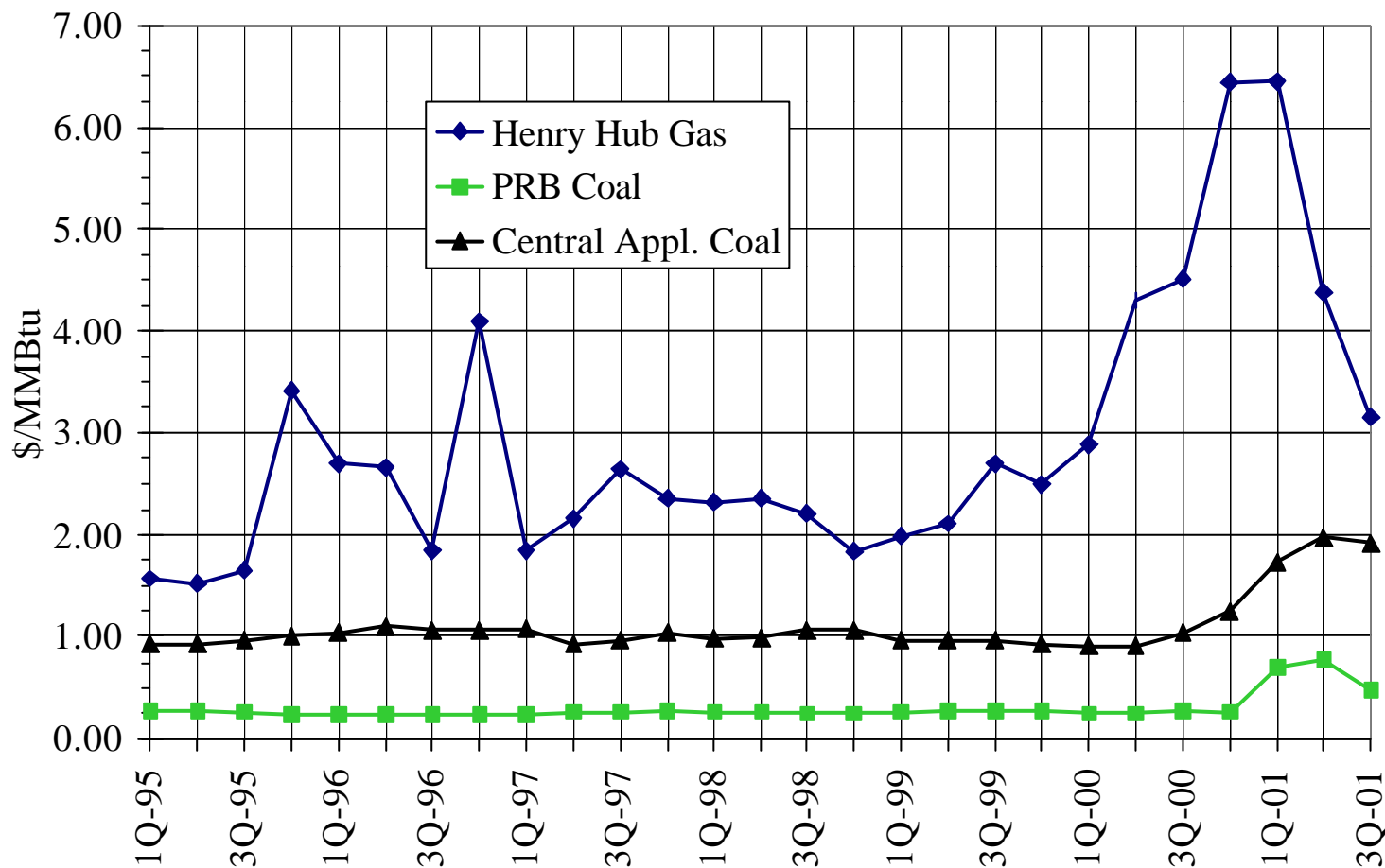


Regulated Utility
and Public Power
Interest in Coal



Average Price of Gas vs Coal

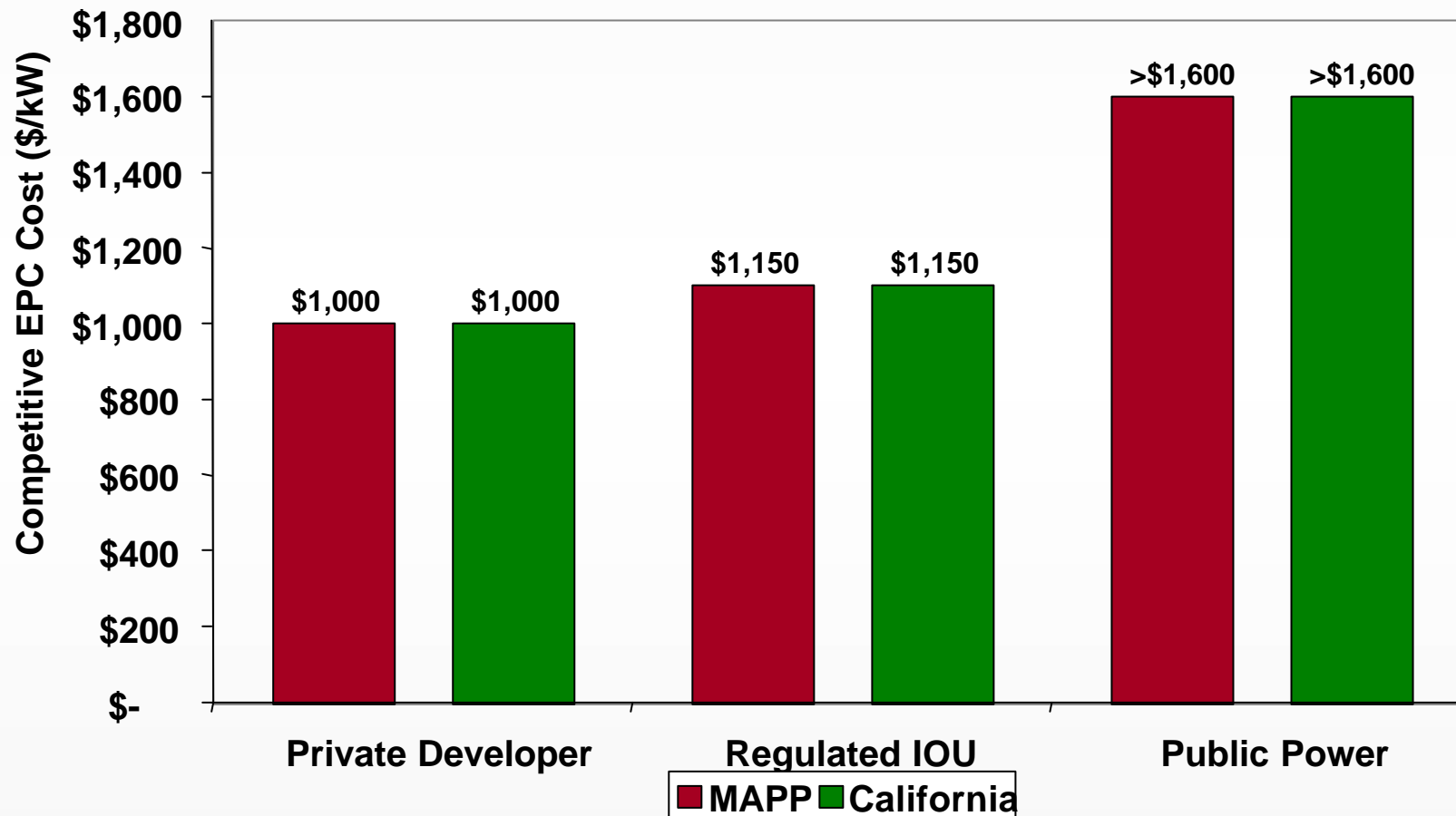
Average Spot Prices



Source: EIA / Enerfax / Coal Outlook

Regulated and Public Power Economics

Threshold Construction Cost for New Coal Fueled Capacity



** Expected Natural Gas Prices*

Implications for Coal Industry Suppliers

- A Lot of New Coal Plants Will Be Studied and Initially Developed
 - Private Financing Will Dictate the Use of Large Plant Designs, The Use of Multiple Unit or Existing Sites and Access to Very Competitive Coal Prices
 - Public Utilities May Still See Value in Smaller Single Unit Plants



Implications for Coal Industry Suppliers

- The Probability a Plant Will Proceed Depends on the Electric Market Which Depends on Gas Prices and the Need for New Generation
- Delivered Coal Prices Are a Key Determinant As Well
- Good Site Selection is Crucial

